## Calculus Warm Up #3-4

1. Find the point slope form of the equation for the line tangent to f(x) at x = -2

$f(x) = 4x^3 + 2x^2 - 6x$

2. Use the limit definition of the derivative to find f´(x)

$f(x) = \frac{\sqrt{x - 2}}{3}$

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In Exercises 1–8, find $f'(x)$ and $f'(c)$.

| *Function* | *Value of c* |
|---|---|
| 1. $f(x) = \frac{1}{3}(2x^3 - 4)$ | $c = 0$ |
| 5. $f(x) = (x^3 - 3x)(2x^2 + 3x + 5)$ | $c = 0$ |

In Exercises 9–24, differentiate the given function.

9. $f(x) = \frac{3x - 2}{2x - 3}$

13. $f(x) = \frac{x + 1}{\sqrt{x}}$ $\rightarrow x^{1/2}$

Quotient Rule:

$f'(x) = \frac{x^{1/2}(1) - (x+1)\frac{1}{2}x^{-1/2}}{(\sqrt{x})^2}$

$f'(x) = \frac{1}{x}\left(\frac{2\sqrt{x}}{2\sqrt{x}} \cdot \frac{\sqrt{x}}{1} - \frac{x+1}{2\sqrt{x}}\right)$

$f'(x) = \frac{1}{x} \cdot \frac{2x - x - 1}{2\sqrt{x}}$

$f'(x) = \frac{x - 1}{2x^{3/2}}$

**17.** $h(s) = (s^3 - 2)^2$

23. $f(x) = \dfrac{c^2 - x^2}{c^2 + x^2}$

In Exercises 25–30, complete the table without using the Quotient Rule (see Example 6).

| *Function* | *Rewrite* | *Derivative* | *Simplify* |
|---|---|---|---|
| **25.** $y = \dfrac{x^2 + 2x}{x}$ | | | |
| **29.** $y = \dfrac{3x^2 - 5}{7}$ | | | |

In Exercises 31–34, find the second derivative of the given function.

**33.** $f(x) = \dfrac{x}{x - 1}$

Quotient Rule

$f'(x) = \dfrac{(x-1)(1) - x(1)}{(x-1)^2}$

$f'(x) = \dfrac{-1}{x^2 - 2x + 1}$

Quotient Rule again:

$f''(x) = \dfrac{(x-1)^2(0) - (-1)(2x-2)}{(x-1)^4}$

$= \dfrac{2(x-1)}{(x-1)^4}$

$= \dfrac{2}{(x-1)^3}$

In Exercises 35–38, find an equation of the tangent line to the graph of the given function at the indicated point.

| *Function* | *Point* |
|---|---|
| **37.** $f(x) = (x^3 - 3x + 1)(x + 2)$ | $(1, -3)$ |

39. Determine the points at which the graph of f(x) has a horizontal tangent. → where $f' = 0$

$$f(x) = \frac{x^2}{x - 1}$$

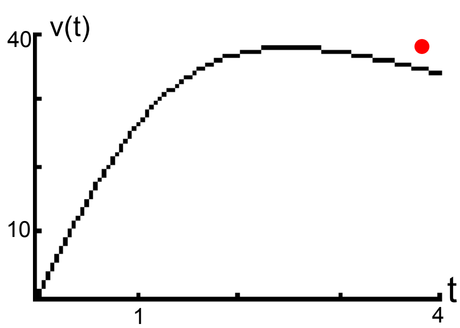
$$f'(x) = \frac{(x-1)(2x) - x^2(1)}{(x-1)^2}$$

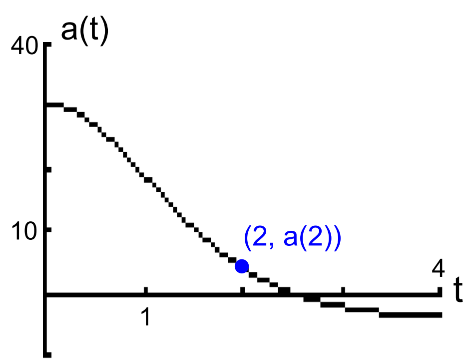
$$f'(x) = \frac{x^2 - 2x}{(x-1)^2}$$ ← Now set $= 0$ & solve for x.

Need (x, y) So plug your x's into f(x)

45. Use your grapher to sketch v(t) and a(t), then find acceleration when t = 2.

$$v(t) = \frac{760t}{4t^2 + 25}, \quad 0 \le t \le 4$$




on graph screen, use 2nd CALC, value, 2

3.5 More tools:

-The Chain Rule

-The General Power Rule

-Simplifying Derivatives

This will be FUN!!!

The Chain Rule:
If f and g are both differentiable, then f(g(x)) is differentiable.

inside

derivative of inside

$$\frac{d}{dx}\left[f\left(g(x)\right)\right]=f'\left(g(x)\right)\cdot g'(x)$$

(The derivative of the outside times the derivative of the inside.)

## Decomposing a composite function:

| $y = f(g(x))$ | inside: $u = g(x)$ | $y = f(u)$ |
|---|---|---|
| $y = \sqrt{3x - 2}$ | $3x - 2$ | $\sqrt{u}$ |
| $y = \dfrac{1}{x + 2}$ | $x + 2$ | $\dfrac{1}{u}$ |

Find $\dfrac{dy}{dx}$ for $y = (x^2 + 1)^3$ $u = x^2 + 1$

$y = u^3$

$y' = 3(x^2+1)^2(2x)$ $y' = 6x(x^2+1)^2$

General Power Rule:

If $y = [u(x)]^n$, where u is differentiable and n is a rational number, then

$$\frac{dy}{dx} = \boxed{n\,[\,u(x)\,]^{n-1}}\left(\frac{du}{dx}\right)$$

Find the derivatives:

1. $f(x) = (3x - 2x^2)^3$

$f'(x) = 3(3x - 2x^2)^2(3 - 4x)$

$f'(x) = (9 - 12x)(3x - 2x^2)^2$

2. $y = \sqrt[3]{(x^2 + 2)^2}$

$y = (x^2 + 2)^{2/3}$

$y' = \frac{2}{3}(x^2 + 2)^{-1/3}(2x)$

$y' = \dfrac{4x}{3\sqrt[3]{x^2 + 2}}$

3. $g(t) = \dfrac{-7}{(2t - 3)^2}$

$g(t) = -7(2t - 3)^{-2}$

$g'(t) = 14(2t - 3)^{-3}(2)$

$g'(t) = \dfrac{28}{(2t - 3)^3}$

4. $f(x) = x^2\sqrt{1 - x^2}$

$f(x) = x^2 \cdot (1 - x^2)^{1/2}$ Need product rule!

$f'(x) = x^2 \cdot \frac{1}{2}(1 - x^2)^{-1/2}(-2x) + 2x(1 - x^2)^{1/2}$

$= \dfrac{-2x^3}{2(1 - x^2)^{1/2}} + \dfrac{2x(1 - x^2)^{1/2}}{1} \cdot \dfrac{(1 - x^2)^{1/2}}{(1 - x^2)^{1/2}}$

$= \dfrac{-x^3 + 2x(1 - x^2)^1}{(1 - x^2)^{1/2}}$

$= \dfrac{-3x^3 + 2x}{(1 - x^2)^{1/2}}$

5. $f(x) = \dfrac{x}{\sqrt[3]{x^2 + 4}}$

Rewrite:

$$f(x) = \frac{x}{(x^2+4)^{1/3}}$$

& use quotient rule

or: $f(x) = x \cdot (x^2+4)^{-1/3}$

and use product rule

:)

5. $f(x) = \dfrac{x}{\sqrt[3]{x^2 + 4}}$

$$f(x) = x\,(x^2+4)^{-1/3}$$

product rule:

$$f'(x) = \underbrace{x}_{f}\underbrace{\left(-\tfrac{1}{3}(x^2+4)^{-4/3}(2x)\right)}_{g'} + \underbrace{(1)}_{f'}\underbrace{(x^2+4)^{-1/3}}_{g}$$

$$f'(x) = \frac{-2x^2}{3(x^2+4)^{2/3}} + \frac{1}{(x^2+4)^{1/3}} \cdot \frac{3(x^2+4)^{3/3}}{3(x^2+4)^{3/3}}$$

$$f'(x) = \frac{-2x^2 + 3x^2 + 12}{3(x+4)^{4/3}}$$

$$f'(x) = \frac{x^2+12}{3(x+4)^{4/3}}$$

:)

HW:

p. 134 #2 - 7,

9 - 33 eoo,

45 - 51 odd